Int. File Number: PCT/EP03/12175

KNORR-BREMSE System für Schienenfahrzeuge GmbH

**BRAKE DEVICE HAVING A PRESSURE-MEDIUM-OPERATED ACTUATOR**

Specification

State of the Art

The invention relates to a brake device having an actuator, which is operated by a pressure medium, for the application and release of a vehicle brake, particularly of a rail vehicle brake, according to Claim 1.

From the state of the art, brake devices having pressure-medium-operated actuators are known where the brake is applied by the controlling of a pressure medium, such as compressed air, into the brake cylinder. This type of an active brake cylinder is used, for example, for the service brake of rail vehicles. Furthermore, pressure-medium-operated actuators with passive brake cylinders are known, where the application of the brake takes place by spring tension and the brake is released by the controlling-in of a pressure medium. Thus, despite a loss of pressure medium, such brakes are operable in the application direction and are used, for example, for parking or emergency braking devices of rail vehicles.

Continuation of Amended Page 1

In the case of a brake device of this type according to European Patent Document EP-A-1 086 867, one of two pressure chambers separated by a piston is ventilated for the application of the brake. When the brake is released, the compressed air in the ventilated pressure chamber promotes the release operation in that it is guided by way of an actuator into the other chamber which is constantly connected with the atmosphere by way of a discharge which cannot be controlled. A pressure head therefore forms in the other pressure chamber which promotes a release of the brake. As a result of the overflowing of the compressed air, the latter is used several times and no longer has to be produced by the pressure medium source. In addition, the braking torque can rapidly be lowered in the event of a breakdown of the rotational wheel speed.

U.S. Patent Document US-A-4 575 159 describes a rail vehicle brake system having a cylinder piston drive in the case of which the piston is spring-loaded in the brake application position.

AMENDED PAGE

Both sides of the piston can be acted upon by pressure medium by means of a control device which utilizes a pressure difference between the piston surfaces for the service brake.

In contrast, the present invention is based on the object of further developing a brake device of the initially mentioned type such that it has a still lower pressure medium consumption as well as a still faster reaction to braking and deceleration demands.

According to the invention, this object is achieved by the characteristics of Claim 1.

Advantages of the Invention

Instead of releasing pressure medium into the environment for the reduction of pressure in the pressure chambers, a portion of the pressure medium present in the respective pressure chamber acted upon by pressure is guided into the other pressure chamber by opening the overflow valve and is utilized there for the pressure buildup. Pressure medium is therefore utilized several times and no longer has to be generated by the pressure medium source. This results in a lower pressure medium consumption of the pressure-medium-operated actuator and therefore in a pressure medium supply with smaller dimensions, particularly in smaller

storage air tanks. As an alternative, while the dimensioning of the pressure medium supply is not changed, the size of the brake cylinder can be reduced in order to generate a defined braking or releasing force, because a portion of the braking or releasing force is generated already by the amount of pressure medium flowing over from one pressure chamber into the other pressure chamber. This is advantageous particularly when the actuator is used in low-floor short-distance vehicles, in the case of which a limited amount of space is available for the brake cylinders. Furthermore, the valve cross-sections of the ventilation valves and bleeder valves can be reduced because only a portion of the pressure medium required for the application and for the release of the brake respectively still flows through them.

Since the overflow valve now also acts during the transition phase between the release position and the application position, the overflowing pressure medium promotes the application operation, which results in a faster reaction to a braking demand. In comparison to European Patent Document EP-A-1 086 867, which utilizes overflowing medium only during the brake release phase, this pressure medium is not immediately discharged but remains in the pressure chamber until a pressure balance occurs, so that the pressure energy present in the pressure medium is optimally utilized.

The ventilation and bleeder valves provide a further increase or decrease of the pressure level adjusted by the overflowing.

By means of the measures indicated in the subclaims, advantageous further developments and improvements of the invention indicated in Claim 1 can be obtained.

According to a particularly preferred embodiment of the invention, the adjusting piston is spring-loaded in the direction of the application position. This will result in an initially described passive brake cylinder. The pressure balancing valve is preferably opened until a fraction of a maximally reachable braking force or releasing force is generated. The maximal force is then achieved by an additional ventilating and bleeding of the respective pressure chambers.

[00015] The actuator, which as a whole has the reference number 1 in Figure 1, is part of a braking device of a rail vehicle and, according to a preferred embodiment, is used for operating a shoe brake 2, which contains a brake shoe 8 coupled with an adjusting piston 6 linearly movable within a brake cylinder 4, which brake shoe 8 interacts with a braking area of a wheel of the rail vehicle, which is not shown for reasons of scale. The brake shoe 8 is preferably fastened to a piston rod 10 of the adjusting piston 6, but a brake linkage may also be arranged in a known manner between the adjusting piston 6 and the brake shoe 8. Instead of a shoe brake 2, a disc brake may also be operated by the actuator 1.

[00016] By means of its two piston sides, which face away from one another, the adjusting piston 6 bounds pressure chambers of which one pressure chamber 12 acts upon the shoe brake 2 in the application position, and the other pressure chamber 14 acts upon it in the release position. The two pressure chambers 12, 14 are each ventilated or bled by one ventilation valve 16, 18 and one bleeder valve 20, 22 respectively, compressed air of a compressed-air source preferably being used as the pressure medium. The two ventilation valves 16,18 are preferably connected on the input side with a pressure medium line 24; on the output side, they lead into the respectively assigned pressure chamber 12, 14. The two ventilation valves 20, 22 are connected on the input side with the respective pressure chamber 14, 12 assigned to them and on the output side with the environment. Furthermore, the two pressure chambers 12, 14 can be connected with one another by way of a pressure medium line 26 having an overflow valve 28, which establishes or blocks the connection depending on the switching condition. The pressure difference between the two pressure chambers 12, 14 is measured by a relative pressure sensor 30 which is connected to the two inputs of the overflow valve 28.

[00017] By means of a spring element in the form of a coil spring 36, which is preferably arranged inside the brake cylinder 4 and is supported on one side on the brake cylinder bottom 32 and on the other side on a piston surface 34 of the adjusting piston 4 pointing away from the brake shoe 8, the adjusting piston 6 is spring loaded in the direction of the application position. The coil spring 36 is therefore accommodated in the one pressure chamber 12 acting upon the adjusting piston 6 in the application position. The ventilation valves 16, 18, the bleeder valves 20, 22 and the overflow valve 28 are controlled by a control device, which is not shown for reasons of scale, which control device switches them as follows:

[00018] Starting from a release position of the shoe brake 2, in which the other pressure chamber 14 acting upon the adjusting piston 6 against the spring force of the coil spring 36 in the release position is maximally ventilated and the one pressure chamber 12 is maximally bled, upon a brake demand signal, at the start of a transition phase between the release position and the application position, the ventilation valves 16, 18 and the bleeder valves 20, 22 remain closed but the overflow valve 28 is and opened. This situation is illustrated in Figure 1, the arrow illustrating the flow direction of the compressed air. As a result, the compressed air, which is at a higher pressure, flows from the other pressure chamber 14 into the one pressure chamber 12. The overflow valve 28 will preferably remain open until essentially a pressure balance exists between the two pressure chambers 12, 14, which is detected by the relative pressure sensor 30. As an alternative, the overflow valve 28 can already be closed before the pressure balance has been reached. Under the effect of the coil spring 36 and of the pressure increased in the one pressure chamber 12, the adjusting piston 6 moves in the direction of the application position and builds up a braking force, which corresponds to a fraction of a maximally achievable braking force, preferably to approximately 50% of the maximally achievable braking force. The overflow valve 28 closes after the pressure balance has been achieved.

[00019] For building up a higher braking force, for example, the maximal braking force, the ventilation valve 16 of the one pressure chamber 12 is opened and external compressed air of the compressed-air source is fed. Simultaneously, the ventilation valve 22 of the other pressure chamber 14 is opened, as illustrated in Figure 2. The pressure in the one pressure chamber 12 therefore continues to rise, while the pressure in the other pressure chamber 14 continues to fall.

[00020] Starting from the application position with the maximal braking force, at the start of a transition phase between the application position and the release position while the ventilation and bleeder valves 16, 18, 20, 22 are closed, the overflow valve 28 is opened again in order to preferably cause a pressure balance by the flowing-over of compressed air from the one pressure chamber 12 into the other pressure chamber 14, as indicated by the arrow in Figure 3. In this case, the braking force affecting the brake shoe 8 decreases to, for example, 50% of the maximally reachable braking force.

[00021] For the further reduction of the braking force and for the complete release of the shoe brake 2, the bleeder valve 20 assigned to the one pressure chamber 12 is opened, and by way of the also opened ventilation valve 18 of the other pressure chamber 14, external

compressed air is fed into the other pressure chamber 14. This situation is illustrated in Figure 4.

**[00022]** Summarizing, the overflow valve 28 is therefore opened at least during a portion of the transition phase between the release position and the application position and/or between the application position and the release position, and is otherwise closed.

LIST OF REFERENCE NUMBER

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| 1 | Actuator |
| 2 | shoe brake |
| 4 | brake cylinder |
| 6 | adjusting piston |
| 8 | brake shoe |
| 10 | piston rod |
| 12 | pressure chamber |
| 14 | pressure chamber |
| 16 | ventilation valve |
| 18 | ventilation valve |
| 20 | bleeder valve |
| 22 | bleeder valve |
| 24 | pressure medium line |
| 26 | pressure medium line |
| 28 | overflow valve |
| 30 | pressure sensor |
| 32 | brake cylinder bottom |
| 34 | piston surface |
| 36 | coil spring |